



Kokanee Abundance, Distribution, and Evolutionary Ecology in Katmai National Park

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Talk Outline

- Introduction & Purpose
 - Locations
 - Previous Studies
- Methods
- Results to date
- Work in progress
- Conclusions



Intro - Kokanee

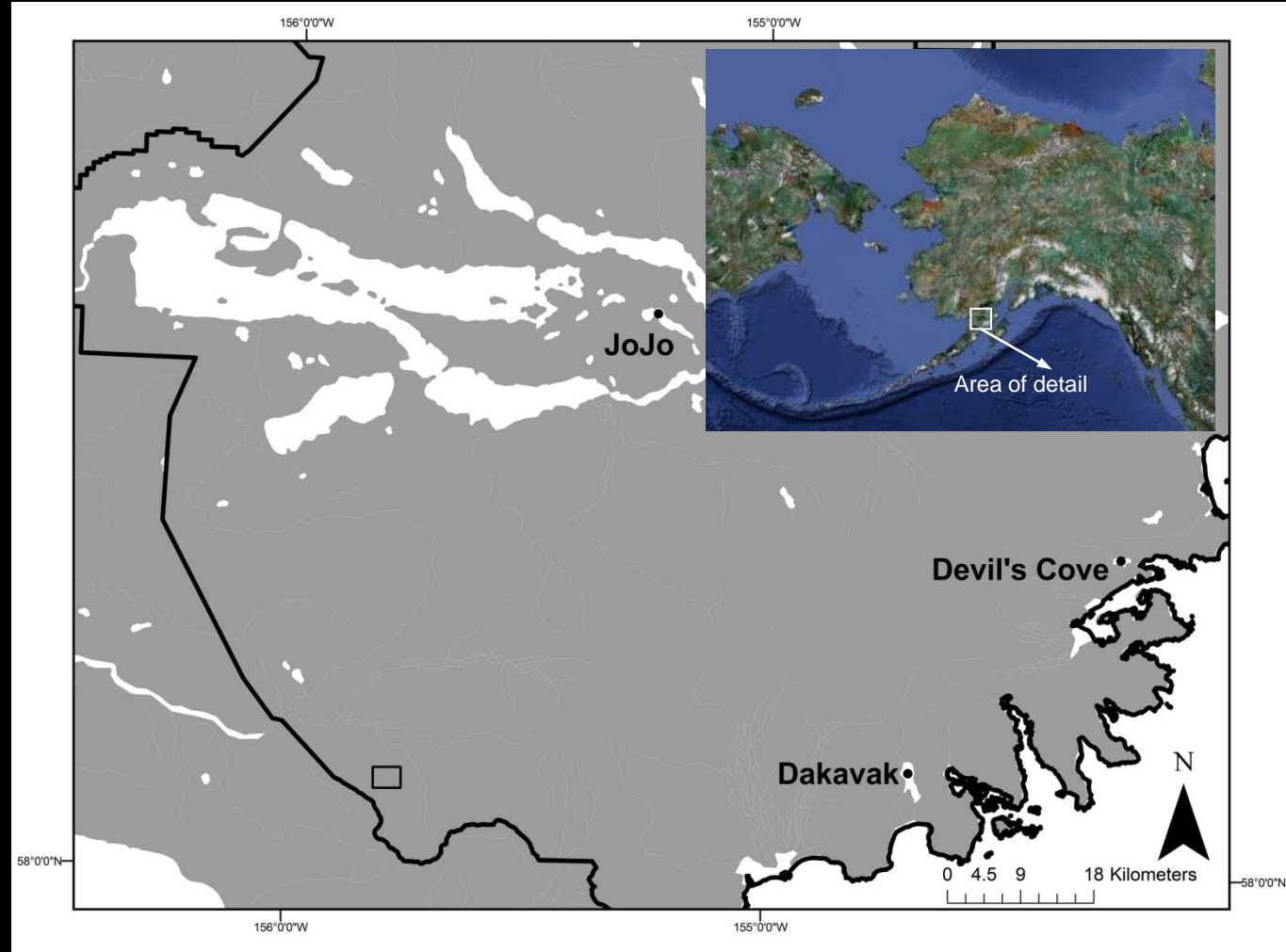
- Nonanadromous sockeye salmon
 - No ocean phase
- Lack of kokanee in AK and Bristol Bay
- Important element of freshwater ecosystem
- Jo-Jo Lake → atypical population
- What is density of KATM kokanee ???
- What can be learned about unique population(s) ???
 - Species interactions
 - Speciation



Location of Lakes

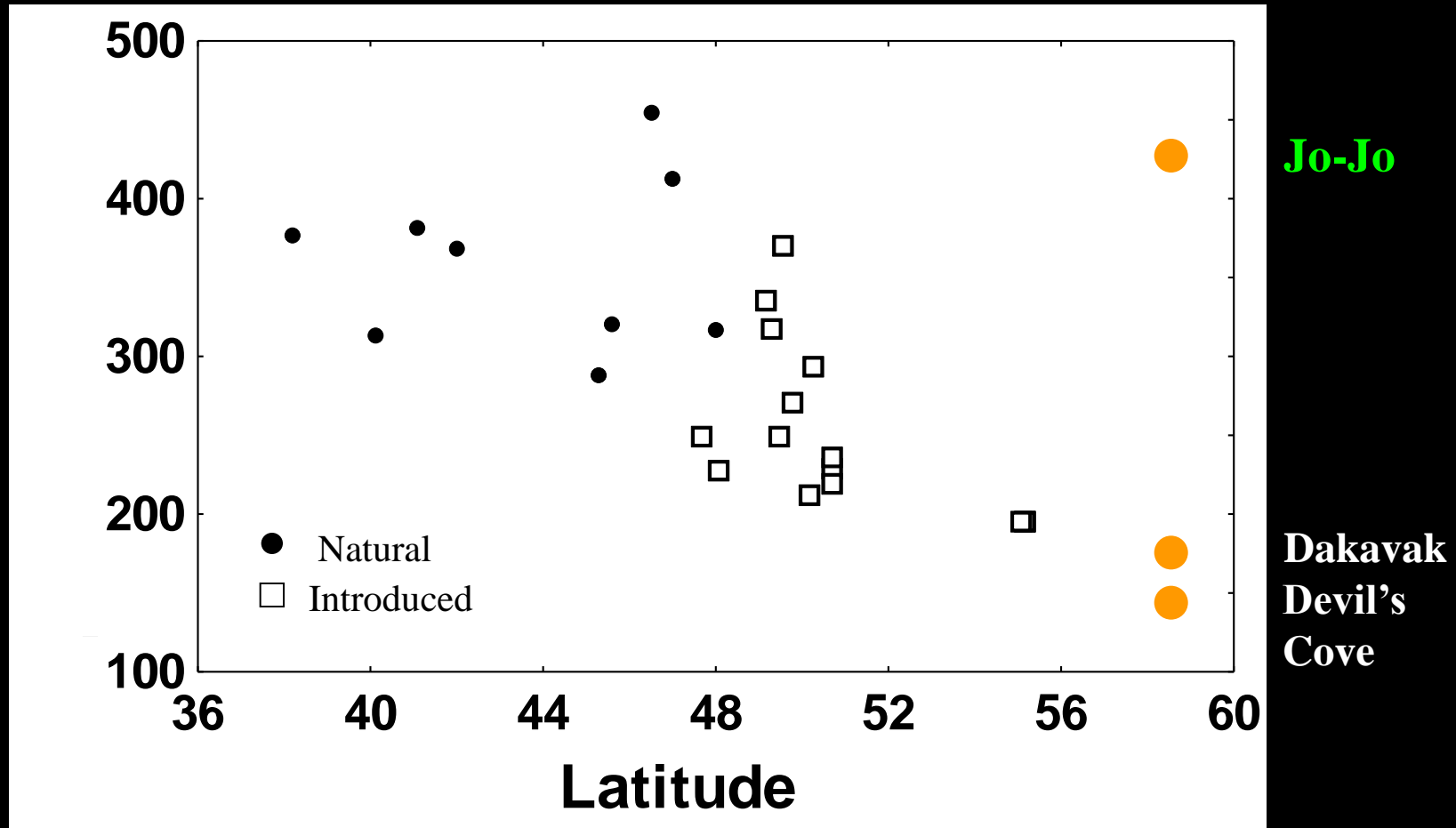
Characteristics

- Drainage
- History of nonanadromy
- Species composition



Previous Research at Jo-Jo Lake

- Large kokanee



* Adapted from McGurk 2000

Previous Research at Jo-Jo Lake

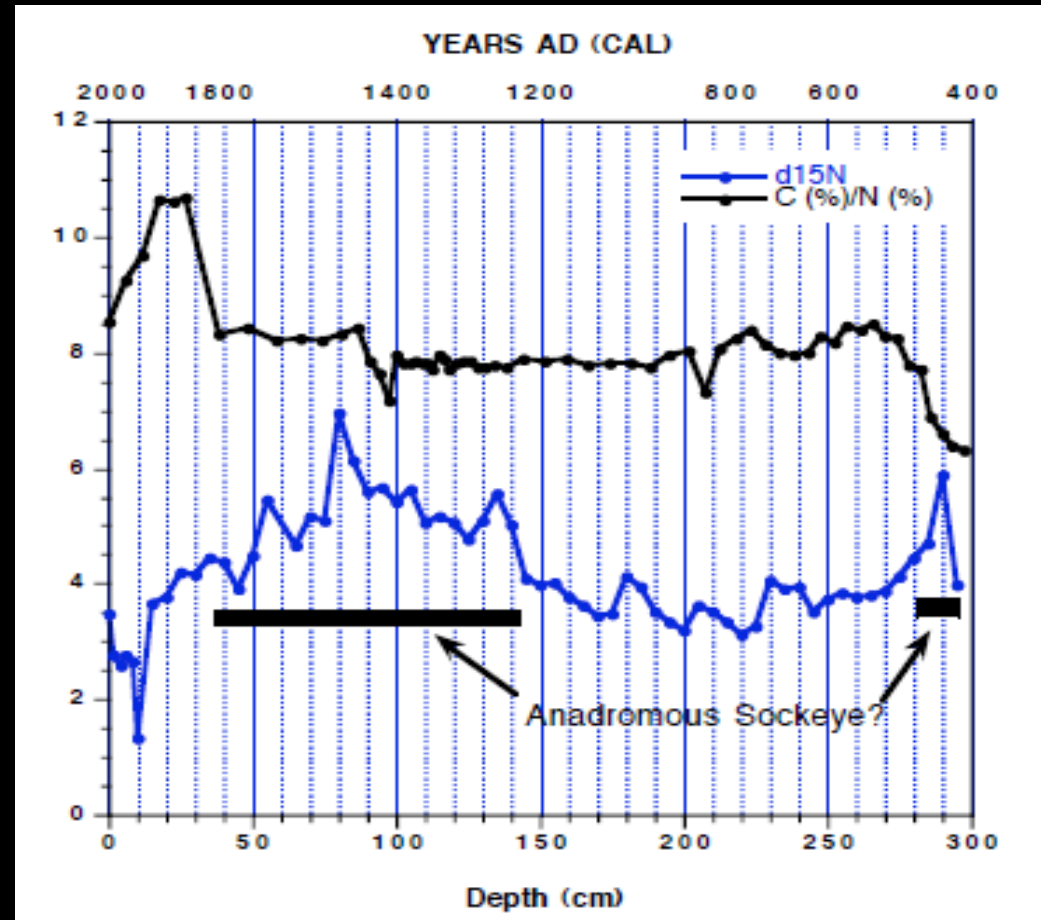
- Large kokanee
 - Unique feeding ecology
 - Higher trophic level
- No limnetic predators

<u>Prey</u>	<u>% occurrence</u>
Leech	50.0
Terrestrial insect	29.4
Stickleback	23.5
Aquatic insect	14.7
Bivalve	11.8
Zooplankton	5.9

***n* = 34 (non-empty stomachs)**

Previous Research at Jo-Jo Lake

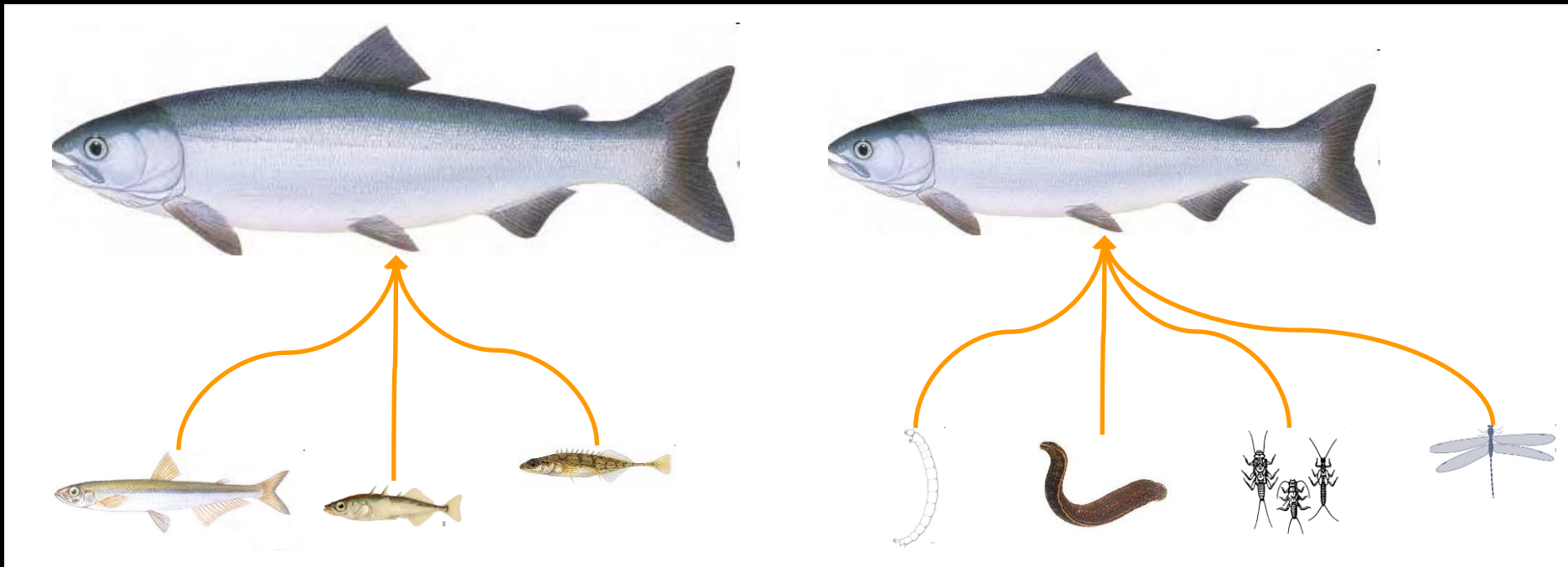
- Large kokanee
 - Unique feeding ecology
 - Higher trophic level
- No limnetic predators
- Recent loss of anadromy
 - < 250 yrs



$\delta^{15}\text{N}$ and $\text{C}(\text{‰})/\text{N}(\text{‰})$ profiles for Jo-Jo Lake over the past ~1600 years.

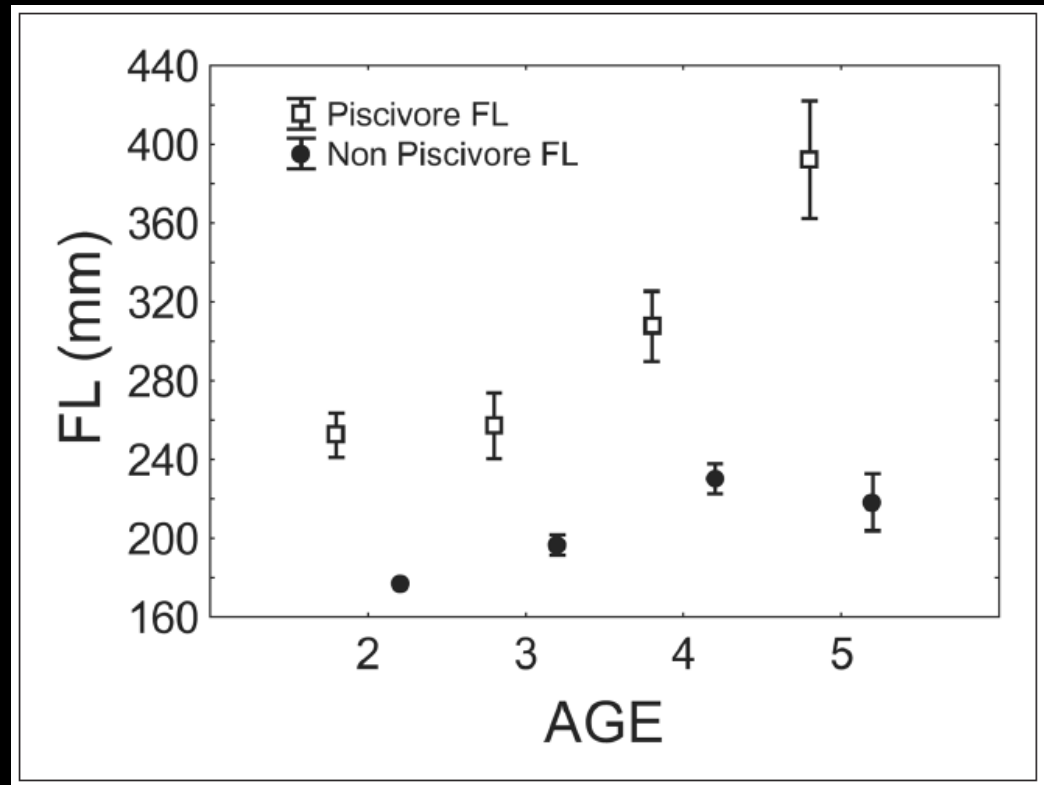
Previous Research at Jo-Jo Lake

- Species pair – 2 ecotypes
 - Piscivorous → Stickleback
 - Nonpiscivorous → Leeches & insects



Previous Research at Jo-Jo Lake

- Species pair – 2 ecotypes
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- Evidence
 - Length at age



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 - **Flesh color**
 - Carotenoid content



Previous Research at Jo-Jo Lake

- Species pair – 2 ecotypes
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- Evidence
 - Length at age
 - Flesh color
 - Carotenoid content
 - Gill raker morphology



Jo-Jo Methods

- Mark & Recapture
 - Hook and line → Mark
 - Length and genetic sample
 - Gillnet & Hook and line → Recapture
 - Genetic sample
 - Scale
 - Muscle sample → $\delta^{13}\text{C}$ & $\delta^{15}\text{N}$ isotopes
 - Stomach contents
 - Head → Morphology



Jo-Jo 2010 Population Estimate

- Defined age structure
 - Separate analysis for adults (2+ yrs) and juveniles (1yr)
- NOREMARK → JHE Closed Population Model
 - Maximum likelihood model → Petersen estimator
- Adult Estimate
 - # Marked = 100 # Recaptured = 3
 - $\hat{N}_C = 2665$ 95% CI → 1171 – 8493
- Juvenile Estimate
 - # Marked = 500 # Recaptured = 12
 - $\hat{N}_C = 5591$ 95% CI → 2420 – 18800
 - Conservative → Sum of estimate from multiple sites

Dakavak & Devil's Cove Lake Methods

- Previous work suggests large population size
 - Smaller size
 - Lower trophic level
 - Species interactions
- Considerations for M&R
 - Logistics of capture → low CPUE → lots of time
 - Assumptions
 - No mortalities
 - Necessity of recaptures for meaningful estimate and CI
- Alternatives???

Genetics → Effective Population Size

- Obtain genetic samples from Dakavak & Devil's Cove → calculate N_E
 - Gillnets and hook & line
 - Fin clip
 - Fork length
 - Otoliths → age (3 yrs)
- 14 tetranucleotide microsatellites
- Microsatellite data → calculate N_E

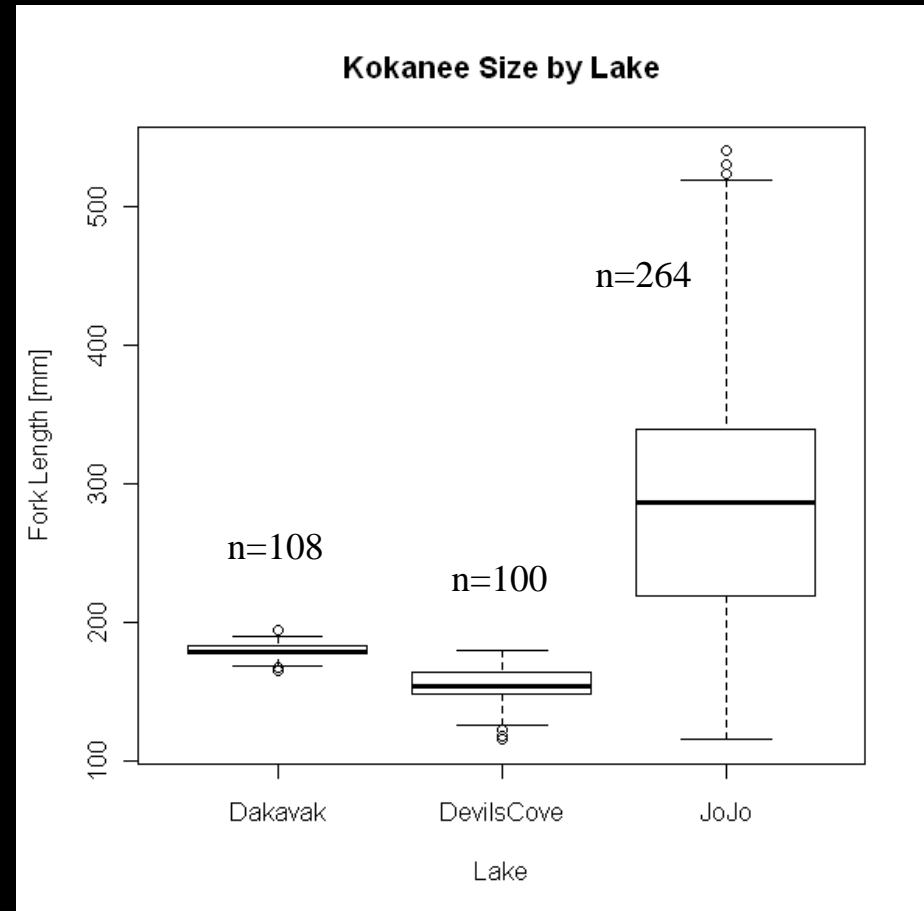


Jo-Jo Current Work in Progress

- Genetics
 - Effective population size $\rightarrow N_E$
 - Genetic differentiation $\rightarrow F_{ST}$
 - If yes, reproductive isolation?
 - Isolation with Migration \rightarrow Estimate time of divergence
- Stomach contents + $\delta^{13}C$ & $\delta^{15}N$ isotopes
 - Diet differentiation?
- Morphology
 - Trophic polymorphism?

Importance of Species Interactions

- Dakavak & Devil's Cove vs. Jo-Jo
 - Competition
 - threespine stickleback
 - Dolly Varden
 - Predation
 - Dolly Varden
- Pike predation at Jo-Jo?



Kruskal-Wallis Rank Sum $p < .001$

Summary of Findings

- Three kokanee populations
 - Dakavak & Devil's Cove → “typical kokanee”
 - Planktivorous
 - Low trophic level
 - Smaller size
 - Larger population ?
 - N_E Estimates from microsatellites
 - Jo-Jo is unique
 - Large → Diet
 - Species pair ?
 - Stomach contents, gill rakers, and flesh coloration → YES
 - Genetics, isotopes, geometric morphometrics → ???
 - Smaller population → N_C estimate and N_E estimate

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